sufficient current for running the instruments until nearly the expiration of the 40-hour limit, or at least until the next morning. The wind direction and velocity and the telethermograph are run from one battery of two cells, and the sunshine and rain gage could also be connected with the same battery if the circuits on the new triple register were properly arranged, as this battery has sufficient electro-motive force for running all the instruments. It might be asked in case of a continued high velocity for twenty-four hours, or more, if the force of the battery would not be so exhausted as to cease to do the work. The answer would be that the electro-motive force is constant almost to the 40-hour limit, and that there is no danger of the battery not having ample force to do the work. The internal resistance is remarkably low and the construction enables the cell to be charged at a minimum electro-motive force, and to be discharged at a maximum.

The elements of the American storage cells consist of two plates made from solid sheets of pure rolled lead, grooved on both sides, separated by a rubber separator, and bound together with large rubber bands, and the "active material" is formed from the lead itself by an electro-chemical process, and is strongly adherent. The fluid consists of a mixture of one part by volume of sulphuric acid to five parts of water. As now arranged the second battery runs the sunshine recorder and rain gage, and it is also intended to put all the electric bells in the office on this battery.

The batteries have now (July 17) been in operation since May 28, and they are doing good work. The life of the battery for our light work is thought to be from five to ten years before the elements have to be renewed, and at the present price the cost for renewing the elements would be about one-half the original cost. The original cost was about $45 for the entire equipment.

IRRIGATION BY WIRE.[1]

By ARTHUR BETTS, Voluntary Observer, Weather Bureau, Ridgeway, Iowa.

(1) *June* 12, 1899.—My idea is to collect moisture from the air. Wire will do the work; it will take the moisture, which will roll down in drops, to the ground. We want poles about ten feet high. Only a few are required to the acre, and five acres in the square form would not take more than 50 poles. Put on the wire and make a complete network of wire overhead, joining from every direction, and in those countries where mountain or river irrigation is impossible man will be his own rainmaker. The wire might be painted green or blue, those being cool colors and capable of condensing more moisture. This would be a cheap means of irrigation. The idea first occurred to me a year ago.

(2) *July* 14, 1899.—Some time ago I wrote to you about collecting moisture through the medium of wires and received a reply stating that you wanted me to make some successful experiments. * * * I have the affair in running order and will report to you when I can have sufficient data. I have already made one successful experiment; but, as in the heat of summer fog and mist seem to come at long intervals apart, it may be several months yet before I can report to you on the results of my experiments. We are having much rain, followed by warm sunshine, but not much fog.

[1] Some months ago Mr. Betts informed the Chief of the Weather Bureau that he was confident that the important problem of the utilization of fog in arid regions could be best accomplished by using wire or wire screens as the obstacle to catch the fog and conduct it as drip to the roots of the plants. The Editor requested him to make actual experiments and measurements. The following three communications from him give the story of his first work and its results. Of course similar experiments in other regions are very much to be desired.—ED.

(3) *August* 22, 1899.—The following table shows what can be done with wire as a means of irrigation. The poles, four in number, are 7 feet high and cover 7 by 7 feet, equal 49 square feet, of surface, and the wire is netted in 6-inch squares. The following shows the result in fog, mist, and dew:

The wires were common fence wire. As wood absorbs too much moisture, I used a tin basin 9 inches across and 3 inches deep [to catch and measure the drip.—ED.]. It was round and the sides very nearly perpendicular. During the forty days the Government rain gage collected 3.44 inches precipitation, of which 0.13 inch was fog, mist, and dew, and this 0.13 inch was twelve times that amount by wire [? $\frac{1}{12}$ of the amount—ED.], and the wire was not painted, either. It was quite a sight to see the wire dripping with ten thousand drops in the early morning. My observations show that even dew can be utilized for irrigation purposes. My rule is to place the wire network in squares whose sides are as the square of the altitude, e. g.: At an altitude of 1 meter, 9 square inches; 2 meters, 36 square inches; 3 meters, 81 square inches; 4 meters, 144 square inches; 5 meters, 225 square inches; 6 meters, 324 square inches; 7 meters, 441 square inches; 8 meters, 576 square inches. Thus, the higher the poles the less the amount of wire needed.

As the 6-inch square appears like a speck from a distance, so a speck on the ground beneath would receive all the drops of water from that far off square. My experiments are accurate even to 0.01 inch, and now, having been very successful in this work, I give it to the world, trusting that it will prove a blessing to many.

Observations of drip at Ridgeway, Iowa.

Date and month.	Kind of precipitation.			Duration.		Precipitation.		Remarks.
	Fog.	Mist.	Dew.	Fog or mist.	Dew.	In gage.	By wire.	
1899.				*H'rs.*	*H'rs.*	*Inch.*	*Inch.*	
July 14	fog.	mist.	......	12	......	0.02	0.20	Mist heavy.
15	fog.	......	......	12	......	T.	0.07	Fog unsteady.
17	......	......	dew.	......	10	T.	0.03	Dew heavy.
18	......	....	dew.	......	10	0.00	0.01	Dew copious.
19	......	......	dew.	......	9	T.	0.03	Dew heavy.
20	......	......	dew.	......	9	0.00	0.01	Dew copious.
21	fog.	......	dew.	2	8	0.00	0.02	Fog very light.
22	fog.	......	dew.	4	10	T.	0.05	Fog light; dew heavy.
23	fog.	......	dew.	3	10	T.	0.04	Fog light; dew heavy.
29	fog.	mist.	dew.	5	10	0.01	0.10	Fog unsteady.
Aug. 2	......	.....	dew.	.. ..	10	T.	0.05	Dew very heavy.
3	fog.	mist.	......	5	0	0.04	0.35	Mist and fog heavy.
5	......	......	dew.	......	10	T.	0.03	Dew heavy.
16	......	......	dew.	......	10	0.00	0.02	Dew copious.
18	......	......	dew.	......	10	0.00	0.02	Dew copious.
19	......	......	dew.	......	10	T.	0.04	Dew very heavy.
20	fog.	mist.	......	7	......	0.04	0.34	Mist heavy.
21	......	......	dew.	......	12	0.01	0.09	Dew excessive.
22	......	......	dew.	......	11	0.01	0.08	Dew excessive.
Sums	8	4	15	50	149	0.13	1.58	

The last line shows the sums for the nineteen dates on which there was fog, mist, or dew (on the remaining twenty-one dates, out of the total, forty, there appears to have been nothing to measure.)

We quite sympathize with the enthusiasm shown by Mr. Betts in his communications on this page, and have no doubt that his experiments will lead to others of equal or greater value. We can easily understand that every wire, or every piece of woven wire fence stretched in the free air will catch fog and dew and lead it to the ground, but we do not understand why the wire should lie horizontally instead of hanging vertically, nor do we understand the argument that requires all the drops of water from a small 6-inch square of wire near the ground and those from a 24-inch square four times farther from the ground to fall upon the same "speck beneath." It is more natural to suppose that the drip from a large horizontal surface of wire will fall vertically upon the same horizontal surface of ground. We do not see how the moisture caught by 2 square feet of wire network 8 yards above the ground, or that caught by a single loop of wire 2 feet square can be concentrated upon an area of 3 inches square at 1 meter above the ground, or upon a single point at the ground, unless there be some arrangement like a funnel to concentrate the drip.

But apart from any question as to the accuracy of our correspondent's logic, we are inclined to believe that woven wire network, such as is used for fences, may constitute an excellent arrangement for catching fog, mist, and dew. Why can not the network be placed vertically, or nearly so, as suggested on page 466 of the MONTHLY WEATHER REVIEW for October, 1898, so that the vertical drip may be led directly into the ground or to the roots of plants by appropriate small inclined gutters.

With regard to the amount of drip caught in these experiments by Mr. Betts, we make the following calculation: He states that he caught the drip from a common fence wire netted in 6-inch squares and stretched horizontally between four poles 7 feet above the ground and covering an area of 7 by 7 feet equal 49 square feet. There were, therefore, 196 open spaces, each 6 inches square, and the total length of wire was 105 linear feet. The drip from this was caught in a tin basin, nearly cylindrical, 9 inches in diameter and 3 inches deep. During the whole forty days a depth of 1.58 inch was collected. This is equivalent to $1.58 \times 4.5 \times 4.5 \times 3.1416 = 100.5$ cubic inches. If this total amount of drip be divided by the area (49 square feet) over which it was collected, we find that it would cover this whole area to a depth of about $\frac{1}{70}$ of an inch. On the other hand, the sum total of the water caught by Mr. Betts in his rain gage in the form of dew was 0.13 in depth. But in this case the dew in the gage must have been deposited on the area of the gage mouth itself; that is to say, the depth, 0.13 on the bottom of the gage or the basin would also have been caught over the whole of the 49 square feet, or for that matter over the whole of a large field. We should say, therefore, that the drip from the fog and mist as caught on the wire screen represents an average depth of water over the field of $\frac{1}{70}$ of an inch, but that the dew represents one-seventh or one-eighth of an inch. Since, therefore, the dew is in this case ten times that of the drip, it is evident that in Iowa the utilization of the dew is more important to irrigation than that of the drip. On the other hand, there may well be regions where the dew is less important and the drip more important. In such cases we doubt not that a thickly set system of woven fence wire in parallel vertical frames may catch enough drip to be an important aid in the irrigation of a small portion of the ground.—ED.

CLIMATOLOGY OF THE ISTHMUS OF PANAMA.[1]

By Gen. H. L. ABBOTT (dated Paris July 12, 1899.)

I enclose the latest figures with respect to rainfall. The complete series for three stations is given in the following table: Gorgona, being near Gamboa, has been lately abandoned as a gaging station:

Bohio.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1898 ...	12.36	1.26	3.03	10.59	14.61	19.76	34.96	38.31	13.31	28.23	21.81	6.38	204.61
1899 ...	9.41	4.49	3.27	11.30	10.36	14.80	......	......	......	......	......	......	.....

[1] The Editor has received the following data from General Abbott, supplementary to his article in the MONTHLY WEATHER REVIEW for May, 1899.

Gamboa.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1898 ...	2.76	0.12	0.00	1.42	5.32	4.65	18.43	20.16	4.10	8.70	14.57	2.40	82.60
1899 ...	5.00	1.73	1.34	1.42	8.54	8.78	.....	.....	......	....	.....	......	......

Gorgona (now abandoned).

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
1898 ...	3.42	0.20	0.00	1.38	5.04	4.37	18.50	19.88	......	7.72	9.61	3.94	[78.0]
1899 ...	3.78	2.01	3.31	.....	.....	......	.....	......	......	......	.....	......	......

I add a rough plot comparing your horary barometric curve at Colon with our mean at Panama. It is certainly gratifying to find so close an accordance. The entire diurnal range is very small, only $2\frac{1}{2}$ millimeters, or .1 of an inch. The difference in epoch is partly explained by your using seventy-fifth meridian time, while we use local time. As your observations are now discontinued, I thought it worth while to reduce the eight months that have been published in the MONTHLY WEATHER REVIEW. Many years ago, I had occasion to study similar diurnal curves in the interior of the North American continent in connection with our Pacific Railroad surveys, and found wide differences at the same place, due to changes of temperature. As such changes do not exist on the Isthmus, we ought to expect harmony between different series in that region and these two sets of observations, in my judgment, confirm this expectation.

The figures and curve given by General Abbott, for the hours of local mean time in the MONTHLY WEATHER REVIEW, May, 1899, pages 201–202, from three months' observations by Royer, at Panama, may be compared with the following table now given by him, as derived from eight months of Weather Bureau observations at Colon on seventy-fifth meridian time. Panama is in longitude 79° 30′ W.; Colon is in longitude 79° 50′ west. Therefore, the time scale of the Colon record for the Weather Bureau barograph still needs a subtractive correction of nineteen minutes in order to convert it into local mean time, and a similar correction of eighteen minutes in order to convert it into a simultaneous record on Panama mean time.

The hourly record for eight months, October 18, 1898, to May 20, 1899, at Colon is given in Table IV in the successive MONTHLY WEATHER REVIEWS, in English inches. It has been converted into millimeters by General Abbot, and has given him the following average departures from monthly mean values. The reconversion into inches has been added by the Editor. The Colon record from November, 1897, to January, 1898, is copied from General Abbot's previous paper. A long record of hourly readings at these two stations is greatly desired.

Mean barometric departures.

Hour.	Colon.		Panama.		Hour.	Colon.		Panama.	
	Mm.	*Inch.*	*Mm.*	*Inch.*		*Mm.*	*Inch.*	*Mm.*	*Inch.*
Midnight .	+ 0.53	+0.021	+ 0.33	+0.013	1 p. m ...	− 0.06	−0.002	....	....
1 a. m	+ 0.19	+0.007	....	....	2 p. m ...	− 0.56	−0.022	− 0.97	− 0.038
2 a. m	− 0.10	−0.004	− 0.40	−0.016	3 p. m ...	− 1.04	−0.041	− 1.20	− 0.047
3 a. m ...	− 0.40	−0.016	− 0.53	−0.021	4 p. m ...	− 1.17	−0.046	− 1.17	− 0.046
4 a. m	− 0.46	−0.018	− 0.43	−0.017	5 p. m ...	− 1.09	−0.043	− 0.93	− 0.037
5 a. m	− 0.36	−0.014	....	....	6 p. m ...	− 0.89	−0.035	− 0.60	− 0.024
6 a. m	− 0.15	−0.006	+ 0.17	+0.007	7 p. m ...	− 0.55	−0.022	....	....
7 a. m	+ 0.22	+0.009	....	....	8 p. m ...	− 0.16	−0.006	+ 0.30	+ 0.012
8 a. m ...	+ 0.77	+0.030	+ 1.10	+0.043	9 p. m ...	+ 0.25	+0.010	+ 0.63	+ 0.025
9 a. m	+ 1.16	+0.046	+ 1.23	+0.048	10 p. m ..	+ 0.48	+0.019	+ 0.80	+ 0.032
10 a. m ...	+ 1.26	+0.050	+ 1.13	+0.044	11 p. m ..	+ 0.60	+0.024	+ 0.57	+ 0.023
11 a. m ...	+ 1.03	+0.041	....	....	Midnight.	+ 0.53	+0.021	+ 0.33	+ 0.013
Noon	+ 0.61	+0.024	+ 0.07	0.000					